CLAIMS

1. An RFI extraction mechanism for passing a UWB signal while suppressing a narrowband interference signal that overlap said UWB signal in frequency, comprising:

a network having an input terminal configured to receive an incoming signal that includes a UWB signal and the narrowband interference signal, an output terminal, and a circuit configured to have an impulse response having

a first component that has an impulsive shape, and

at least one other component delayed in time from said first component, and having an impulsive shape,

wherein energy from said UWB signal is conveyed to the output terminal and energy from said narrowband interference signal is substantially blocked from being output through the output terminal.

2. An RFI extraction mechanism as claimed in Claim 1 wherein an amount of delay between the first component and the at least one second component is electrically adjustable.

3. An RFI extraction mechanism as claimed in Claim 1 wherein an amount of delay between the first component and the at least one second component is mechanically adjustable.

4. An RFI extraction mechanism as claimed in Claim 1 wherein:

said output terminal of said network is connected to a terminating load of predetermined impedance;

said circuit comprising at least one section, connected in series through at least one of an isolation device, a circulator, and an amplifier, said at least one section including:

a first transmission line having a predetermined characteristic impedance matched to a source impedance of a device that provides the incoming signal, and configured to convey said incoming signal;

a second transmission line having a second characteristic impedance and configured to convey a portion of said incoming signal from said first transmission line for a predetermined distance and reflect said portion of said incoming signal; and

a receiving transmission line having a third characteristic impedance matched to said terminating load and configured to receive respective portions of said incoming signal from said first transmission line and a reflected portion of said incoming signal from said second transmission line, and having as an output said output terminal.

5. An RFI extraction mechanism as claimed in Claim 4, wherein said characteristic impedance of said second transmission line is substantially equal to a parallel combination of said characteristic impedance of said first transmission line and said characteristic impedance of said receiving transmission line.

6. An RFI extraction mechanism as claimed in Claim4, wherein said second transmission line is connected to the first transmission line and the receiving transmission line at one end thereof and a node held at a predetermined potential at an opposite end.

7. An RFI extraction mechanism as claimed in Claim4, wherein an electrical length of said second transmission line is substantially at least one of a quarter wavelength and any number of multiples of 1/2 wavelength of a primary frequency of said narrowband signal, and a reflection in said second transmission line is caused by said second transmission line appearing to said narrowband signal as a substantially open circuit.

8. An RFI extraction mechanism as claimed in Claim 4, wherein an electrical length of said second transmission line is substantially at least one of a 1/2 wavelength and any number of multiples of 1/2 wavelength of a primary frequency of said narrowband signal, and a reflection in said second transmission line is caused by said second transmission line appearing to short circuit at the frequencies of interest.

9. An RFI extraction mechanism as claimed in Claim 4, wherein the first transmission line having said predetermined impedance of substantially 50 ohms, the receiving transmission line having said third impedance of substantially 50 ohms, and the second transmission line having said second impedance of substantially 25 ohms.

10. An RFI extraction mechanism as claimed in Claim 4, further comprising:

a varactor connected across said second transmission line which adjusts the electrical length of said second transmission line so as to tune the delay and provide an electronically tunable notch operator at the primary frequency of the narrowband signal.

11. An RFI extraction mechanism as claimed in Claim 1, wherein:

said output terminal of said network is connected to a terminating load of a predetermined impedance;

said network includes at least one section, connected in series and each section including,

a two-way splitter having said input terminal an input, a first output, and a second output,

a delay element having an input connected to the first output of said two-way splitter, and having an output, and

a combiner having

a first input connected to the output of said delay element,

a second input connected to the second output of said two-way splitter, and

the output terminal as an output.

12. An RFI extraction mechanism as claimed in Claim 11 wherein said delay element comprising:

a plurality of amplifiers, at least one of said plurality of amplifiers having a bias adjustable delay and a delay bias input connected in series.

13. An RFI extraction mechanism as claimed in Claim 11 further comprising:

an isolation device configured couple said splitter to said combiner.

14. An RFI extraction mechanism as claimed in Claim 12 wherein:

said isolation device includes an amplifier.

15. An RFI extraction mechanism as claimed in Claim 12 wherein:

said isolation device is inverting on inverting isolation device.

16. An RFI extraction mechanism as claimed in Claim 11 further comprising:

an isolation device configured to couple said splitter to said delay element.

17. An RFI extraction mechanism as claimed in Claim 16 wherein:

said isolation device includes an amplifier.

18. An RFI extraction mechanism as claimed in Claim 16 wherein:

said isolation device is inverting an inverting isolation device.

19. An RFI extraction mechanism as claimed in Claim 11 further comprising:

an isolation device configured to couple said output terminal to said splitter.

20. An RFI extraction mechanism as claimed in Claim 19 wherein:

said isolation device includes an amplifier.

21. An RFI extraction mechanism as claimed in Claim 19 wherein:

said isolation device includes a magnetic circulator device.

22. An RFI extraction mechanism as claimed in Claim 11 wherein:

said delay element includes a transmission line.

23. An RFI extraction mechanism as claimed in Claim 11 wherein:

said delay element includes a series of series L and shunt C sections.

24. An RFI extraction mechanism as claimed in Claim 11 wherein:

said delay element includes a series of series R and shunt C sections.

25. An RFI extraction mechanism as claimed in Claim 23 wherein:

at least one of said shunt C elements is electrically adjustable.

26. An RFI extraction mechanism as claimed in Claim 23 wherein:

at least one of said shunt C elements being a varactor.

27. The RFI extraction mechanism of Claim 1, further comprising:

a monitoring mechanism configured to monitor at least one of a composite output level; and

a controller configured to adjust the amount of delay and determine a predetermined delay that results in the composite output level being a minimum.

28. The RFI mechanism of Claim 27, wherein:

said controller is configured to adjust said amount of delay across a range of delay that corresponds with a bandwidth that contains said UWB signal.

29. A UWB receiver comprising:

an antenna input configured to receive a UWB signal that overlaps in frequency with a narrowband interference signal;

a radio front end;

a tracking correlator configured to detect said UWB signal and a controller configured to control operations of the tracking correlator and radio front end, wherein

said radio front end includes

a network having an input terminal configured to receive an incoming signal that includes a UWB signal and the narrowband interference signal, an output terminal, and a circuit configured to have an impulse response having

a first component that has an impulsive shape, and

at least one other component delayed in time from said first component, and having an impulsive shape,

wherein energy from said UWB signal is conveyed to the output terminal and energy from said narrowband interference signal is substantially blocked from being output through the output terminal.

30. The receiver of Claim 29, wherein an amount of delay between the first component and the at least one second component is electrically adjustable.

31. The receiver of Claim 30, wherein an amount of delay between the first component and the at least one second component is mechanically adjustable.

32. The receiver of Claim 31, wherein:

said output terminal of said network is connected to a terminating load of a predetermined impedance;

said circuit comprising at least one section, connected in series through at least one of an isolation device, a circulator, and an amplifier, said at least one section including:

a first transmission line having a predetermined characteristic impedance matched to a source impedance of a device that provides the incoming signal, and configured to convey said incoming signal;

a second transmission line having a second characteristic impedance and configured to convey a portion of said incoming signal from said first transmission line for a predetermined distance and reflect said portion of said incoming signal; and

a receiving transmission line having a third characteristic impedance matched to said terminating load and configured to receive respective portions of said incoming signal from said first transmission line and a reflected portion of said incoming signal from said second transmission line, and having as an output said output terminal.

33. The receiver of Claim 32, wherein said characteristic impedance of said second transmission line is substantially equal to a parallel combination of said characteristic impedance of said first transmission line and said characteristic impedance of said receiving transmission line.

34. The receiver of Claim 33, wherein said second transmission line is connected to the first transmission line and the receiving transmission line at one end thereof and a node held at a predetermined potential at an opposite end.

35. The receiver of Claim 34, wherein an electrical length of said second transmission line is substantially at least one of a quarter wavelength and any number of multiples of 1/2 wavelength of a primary frequency of said narrowband signal, and a reflection in said second transmission line is caused by said second transmission line appearing to said narrowband signal as a substantially open circuit.

36. The receiver of Claim 35, wherein an electrical length of said second transmission line is substantially at least one of a 1/2 wavelength and any number of multiples of 1/2 wavelength of a primary frequency of said narrowband signal, and a reflection in said second transmission line is caused by said second transmission line appearing to short circuit at the frequencies of interest.

37. The receiver of Claim 36, wherein the first transmission line having said predetermined impedance of substantially 50 ohms, the receiving transmission line having said third impedance of substantially 50 ohms, and the second transmission line having said second impedance of substantially 25 ohms.

38. The receiver of Claim 37, further comprising:

a varactor connected across said second transmission line which adjusts the electrical length of said second transmission line so as to tune the delay and provide an electronically tunable notch operator at the primary frequency of the narrowband signal.

39. The receiver of Claim 38, wherein:

said output terminal of said network is connected to a terminating load of a predetermined impedance;

said network includes at least one section, connected in series and each section including,

a two-way splitter having said input terminal an input, a first output, and a second output,

a delay element having an input connected to the first output of said two-way splitter, and having an output, and

a combiner having

a first input connected to the output of said delay element,

a second input connected to the second output of said two-way splitter, and

the output terminal as an output.

40. The receiver of Claim 39, wherein said delay element comprising:

a plurality of amplifiers, at least one of said plurality of amplifiers having a bias adjustable delay and a delay bias input connected in series.

41. The receiver of Claim 40, further comprising:

an isolation device configured couple said splitter to said combiner.

42. The receiver of Claim 41, wherein:

said isolation device includes an amplifier.

43. The receiver of Claim 42, wherein:

said isolation device is inverting on inverting isolation device.

44. The receiver of Claim 43, further comprising:

an isolation device configured to couple said splitter to said delay element.

45. The receiver of Claim 44, wherein:

said isolation device includes an amplifier.

46. The receiver of Claim 45, wherein:

said isolation device is inverting an inverting isolation device.

47. The receiver of Claim 46, further comprising:

an isolation device configured to couple said output terminal to said splitter.

48. The receiver of Claim 47, wherein:

said isolation device includes an amplifier.

49. The receiver of Claim 48, wherein:

said isolation device includes a magnetic circulator device.

50. The receiver of Claim 49, wherein:

said delay element includes a transmission line.

51. The receiver of Claim 50, wherein:

said delay element includes a series of series L and shunt C sections.

52. The receiver of Claim 51, wherein:

said delay element includes a series of series R and shunt C sections.

53. The receiver of Claim 52, wherein:

at least one of said shunt C elements is electrically adjustable.

54. The receiver of Claim 53, wherein:

at least one of said shunt C elements being a varactor.

55. The receiver of Claim 54, further comprising:

a monitoring mechanism configured to monitor at least one of a composite output level; and

a controller configured to adjust the amount of delay and determine a predetermined delay that results in the composite output level being a minimum.

56. The receiver of Claim 55, wherein:

said controller is configured to adjust said amount of delay across a range of delay that corresponds with a bandwidth that contains said UWB signal.

57. A UWB receiver comprising:

an RFI extraction mechanism including

a first transmission line having a predetermined impedance and configured to convey an incoming signal that includes said UWB signal and said narrowband signal,

a stub having a second impedance and configured to convey a portion of said incoming

signal for a predetermined distance and reflect said portion of said incoming signal, and

a receiving transmission line having a third impedance configured to receive respective portions of said incoming signal from said first transmission line and a reflected portion of said incoming signal from said stub so as to create an impulse response having a first component that has a shape of a wavelet portion of said UWB signal and a second component that is delayed in time and inverted in shape from said wavelet;

a UWB demodulator configured to detect data from a signal output from said RFI extraction mechanism; and

a decoder configured to decode said data from said UWB demodulator so as to produce an output data stream.

58. An RFI extraction mechanism in a radio front end of a UWB receiver, comprising:

means for inverting and time-shifting a first impulse response component and a second impulse response component of the radio front end, each of said first impulse response component and the second impulse response component having an impulsive shape; and

means for adjusting a relative position of said first impulse response component and second impulse response component so as to pass said UWB signal, but substantially cancel a narrowband interfering signal.

59. An RFI extraction mechanism for passing a UWB signal while suppressing a narrowband interference signal that coincides with said UWB signal in frequency, comprising:

a controller configured to controllably adjust a relative position of a first impulse response component and a second impulse response component of a radio front-end, said controller being configured to adjust an amplifier bias of an amplifier in said radio front-end;

a control receiver configured to detect at least one of a signal energy level and a signal to noise ratio of said narrowband interference signal and provide an indication to said controller regarding a characteristic feature of said narrowband interference signal.

60. An RFI extraction mechanism as claimed in Claim 59, wherein the controller further comprises:

a power sensor configured to determine a power level of said narrowband interference signal and inform said controller of said power level.

61. An RFI extraction mechanism as claimed in Claim 60, wherein the controller further comprises:

a memory configured to hold a table of target biases corresponding to frequencies used by said controller when determining the amount of adjustment.

62. An RFI extraction mechanism as claimed in Claim 59, wherein the controller further comprises:

another amplifier connected to said first amplifier by a switch, said controller being configured to adjust a position of said switch to assist in positioning said first impulse response component and said second impulse response component.

63. A UWB receiver comprising:

an RFI extraction mechanism including

a controller configured to controllably adjust a relative position of a first component and a second component of an impulse response function of a radio front-end, said controller being configured to adjust an amplifier bias of an amplifier in said radio front-end,

a control receiver configured to detect a signal energy level and a signal to noise ratio of said UWB signal, and

a sensor configured to detect an output power of said UWB signal;

a bi-phase wavelet demodulator configured to detect data from a signal output from said RFI extraction mechanism; and

a decoder configured to decode said data from said bi-phase wavelet demodulator so as to produce an output data stream.

64. A method for controlling a relative position of a first impulse response component and a second impulse response component of a radio-front end in a UWB receiver, comprising the steps of:

receiving at said radio a UWB signal corrupted with narrowband interference at a predetermined frequency;

determining a relative position of the first impulse response component and the second impulse response component to cancel said narrowband interference;

determining an amplifier bias of an amplifier in said radio front end to achieve said relative position;

accessing a memory table containing a target value for said amplifier bias corresponding to the predetermined frequency; and

sending the target value to the amplifier.

65. The method of claim 64, further comprising steps of:

tracking changes in the predetermined frequency; and

adjusting said target value sent to said amplifier.

66. An adjustable RFI extraction mechanism for passing a UWB signal while suppressing a narrowband interference signal that overlaps said UWB signal in frequency, comprising:

a first transmission line having a predetermined impedance and configured to convey an incoming signal that includes said UWB signal and said narrowband signal;

a second transmission line having a second impedance and configured to convey a portion of said incoming signal for a predetermined distance and reflect said portion of said incoming signal; and

a receiving transmission line having a third impedance configured to receive respective portions of said incoming signal from said first transmission line and a reflected portion of said incoming signal from said second transmission line so as to create an impulse response having a first component that has a shape of a wavelet portion of said UWB signal and a second component that is delayed in time and inverted in at least one of shape and phase relative to multiple cycles of the narrowband interference signal.

67. An adjustable RFI extraction mechanism as claimed in Claim 66, wherein the second transmission line includes

a variable capacitor, and

a voltage source configured to apply voltage to said capacitor.

68. An adjustable RFI extraction mechanism as claimed in Claim 67, wherein the voltage source applies a manually adjustable voltage to said capacitor.

69. An adjustable RFI extraction mechanism as claimed in Claim 67, wherein the voltage source applies a voltage to the capacitor regulated by a voltage controller.

70. A UWB receiver comprising:

an adjustable RFI extraction mechanism including

a first transmission line having a predetermined impedance and configured to convey an incoming signal that includes said UWB signal and said narrowband signal,

a second transmission line having a second impedance and configured to convey a portion of said incoming signal for a predetermined distance and reflect said portion of said incoming signal, and

a receiving transmission line having a third impedance configured to receive respective portions of said incoming signal from said first transmission line and a reflected portion of said incoming signal from said second transmission line so as to create an impulse response having a first component that has a shape of a wavelet portion of said UWB signal and a second component that is delayed in time and inverted in shape from said wavelet;

a bi-phase wavelet demodulator configured to detect data from a signal output from said RFI extraction mechanism; and

a decoder configured to decode said data from said bi-phase wavelet demodulator so as to produce an output data stream.

71. An adjustable RFI extraction mechanism, comprising:

means for time-shifting a first impulse response component and a second impulse response component of a UWB radio front end, each of said first impulse response component and said second impulse response component having a shape of a wavelet of a UWB signal to be received; and

means for adaptively adjusting a relative position of said first impulse response component and said second impulse response component to pass said UWB signal, but cancel a narrowband interfering signal.

72. An RFI extraction mechanism according to Claim 4, wherein a length of at least one of said first transmission line and said receiving transmission line being substantially zero.

73. An RFI extraction mechanism according to Claim 4, wherein respective lengths of said first, second, and receiving transmission lines are independently adjustable in each of the at

least one sections so as to allow narrowband signals at multiple frequencies to be suppressed without suppressing the UWB signal by more than a predetermined amount.

74. An RFI extraction mechanism as claimed in Claim 4, wherein:

said circuit including a plurality of sections, each of said sections configured to suppress energy at a different frequency.

75. The receiver of Claim 31, wherein a length of at least one of said first transmission line and said receiving transmission line being substantially zero.

76. The receiver of Claim 31, wherein respective lengths of said first, second, and receiving transmission lines are independently adjustable in each of the at least one sections so as to allow narrowband signals at multiple frequencies to be suppressed without suppressing the UWB signal by more than a predetermined amount.

77. The receiver of Claim 34, wherein:

said circuit including a plurality of sections, each of said sections configured to suppress energy at a different frequency.